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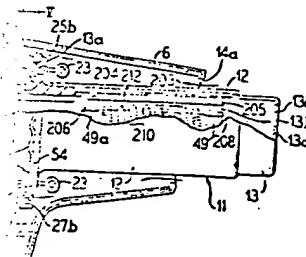
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Europäisches Patentamt

(19) European Patent Office

Office européen des brevets

(11) Publication number:

0170974
A2

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EUROPEAN PATENT APPLICATION

(21) Application number: 85109230.4

⑤1 Int. Cl.⁴: **B 44 D 3/16**

㉒ Date of filing: 23.07.85

(30) Priority: 08.08.84 US 639663
08.08.84 US 639668
08.08.84 US 639371

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(43) Date of publication of application: 12.02.86
Bulletin 86/7

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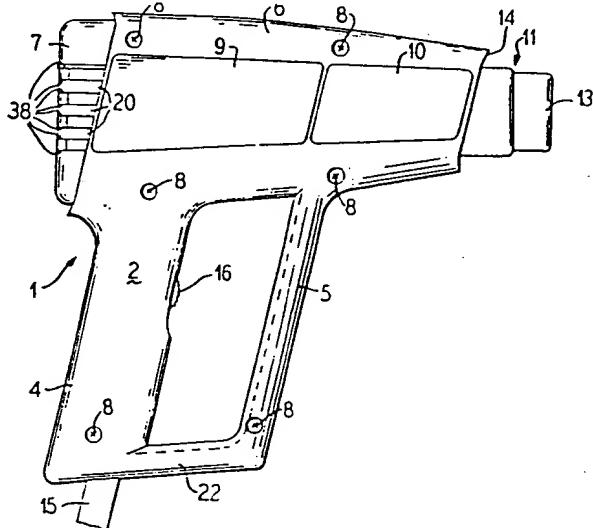
⑧ Designated Contracting States: **DE FR IT**

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54 Hand held hot air blower.

57 A hot air gun or blower of the type useable for blistering paint on a painted surface for easing the removal of paint thereof has a housing (2, 3) with internal brackets (24a-b, 25a-e, 26a-c, 27a-e, 28a-e, 30a-c, 31a-e, 50a-b) supporting and retaining a switch assembly (36), a circuit board (51), a motor (69) having an impeller (40), a motor mount (101), a shroud (41) surrounding the impeller (40), and a heating element (11). The internal brackets supporting these elements are configured so as to provide a number of air passages (60, 61a-b, 62a-b, 63) between the elements and the interior wall of the housing. In addition to drawing air through a rear portion of the gun, air is drawn through an annular opening (14a) in the front of the gun between the cover (12) for the heating element (11) and the housing (2, 3). The air thus passes over the covered heating coil (212) and is preheated before being blown by the impeller (40) directly over the coil (212) for primary heating. At least one wave-like flange (53) is received between spaced interior brackets (26a-b) in the housing for providing a press fit of the components between the two housing halves (2, 3) thus eliminating the need for mechanical fasteners for mounting the components of the gun.

EP 0 170 974 A2



1 HAND HELD HOT AIR BLOWERDESCRIPTION

Many types of hand-held hot air blower devices are known in the art which direct a flow of heated air at an object. Devices of this type which are specifically designed for the purpose of but not limited to directing heat at a painted surface, thereby causing the paint to blister to facilitate the subsequent removal thereof from the surface are described, for example, in United States patents 1,995,240; 2,481,760; 2,577,269; 3,094,606; 10 3,109,083 and 3,115,567.

Such conventional units, in order to achieve the necessary high temperature elevation and required volume of air movement, are cumbersome and generally employ a considerable number of cooperating components, many of which are prone to failure over continued use. Units, 15 of the type such as hand-held hair dryers, sacrifice high temperature elevation and add high volume of air handling in order to achieve the smaller, more manageable size without overheating of inexpensive components. Such units are generally not acceptable for paint removal purposes because those devices cannot attain the necessary air temperature required to effectively blister the paint.

Additionally, various shapes of impellers or fan blades are known in the art for generating an air flow by rotation thereof by means of a motor. Such impellers, regardless of shape, unavoidably impart turbulence and other fluid disturbances to the air by virtue of moving the air at a rapid rate. Such turbulence reduces the smooth flow of air through the remainder of the device thus requiring more work to move a given volume of air through the device and slowing the velocity of air passed a given point in the device. Moreover, if the air moved by the impeller is to be subsequently treated, such as by heating, such treatment may be disturbed or impaired by such high turbulence, and the heating itself may contribute to uneven pressures 30 affecting air flow.

1 Many blowers are thus provided with vanes and other
elements for acting upon the air flow generated by an
impeller or fan in an attempt to "straighten" the air
flow. One such device is described, for example, in
5 USLP 4,039,774 which makes use of a cone having a
plurality of curved veins thereon, the cone being received
in a complimentary-shaped cover, in which a heater assem-
bly is disposed for heating the moving air.

10 Heating coil assemblies are known in the art for
use in various types of hot air blowing devices, such as
paint-removing blowers, hair dryers and the like.

15 Conventional heating coil assemblies are generally
positioned adjacent to a blower fan and have a resistance
heating element, generally in the form of a coil wire,
disposed such that the blower moves air to be heated
axially over the coil, such that when the air exits the
assembly it has been elevated in temperature by the coil.

20 Many conventional units simply have the coil, and
supporting means therefor, disposed openly within the
housing of the blower device, such that the air passage
surrounding the coil is a relatively large volume
defined by the coil itself and the interior wall of the
housing. Examples of such conventional devices are
described in United States patents 3,943,329; 3,947,659;
25 3,109,083; 2,778,919; 2,730,609; 2,041,687; 1,955,240;
1,821,525 and 1,777,744.

30 Other known heating coil assemblies have a sleeve
or other interior means surrounding the coil in the
inside of the device housing, so as to define a smaller
volume for passage of air over the coils. Examples of
devices of this type are described in United States
patents 4,198,556; 3,857,016; 3,668,370; 3,612,824 and
3,094,606.

35 A problem existing in the field of heating coil
assembly manufacture is that of providing a reliable
heating means which can be utilized for purposes
requiring a sufficient volume of extremely hot air, such
as for removing paint from a surface by causing the paint

1 to blister by the application of intense heat thereto,
is that of providing a heating element which meets
these demands which is inexpensive, easy to assemble,
and has relatively few elements. A further problem in
5 the design and manufacture of such heavy duty heating
elements is to provide such an element which generates
sufficient heat for elevating the temperature of a large
volume of air but which is sufficiently insulated from
the remainder of the device so as to not cause a danger
10 to the user.

It is an object of the present invention to pro-
vide a hand-held hot air gun for but not limited to
directing a flow of heated air at a painted surface for
blistering the paint and thereby easing removal thereof
15 from the surface which is lightweight, easily manageable,
and has a simplified construction contributing to a
longer useful life without failure.

It is a further object of the present invention
to provide such a hot air gun which has a number of
20 components retained in a housing with as few mechanical
fastening means as possible.

Another object of the present invention is to
provide such a hot air gun which promotes efficient
operation by preheating air drawn into the unit before
25 the air is directed over a heating means for primary
heating. The air drawn in the front of the unit also
substantially reduces the temperature of outside case;
this allows us to pass U.L. temperature requirement with
lower cost plastics and supplies more operator comfort.

30 A further object of the present invention is to
provide such a hot air gun having a "clam shell" housing
assembly consisting of two halves, each housing half
having a number of brackets for supporting the interior
components, which brackets simultaneously form a number
35 of air passages in combination with the supported
components.

1 It is another object of the present invention to provide an impeller and shroud assembly for a blower device which operate in combination to provide an essentially uniform, low-turbulent air flow.

5 It is an object of the present invention to provide a heating coil assembly for use in a heavy duty hot air blowing device which consists of a small number of elements which are easily assembled and retained.

A further object of the present invention is to
10 provide a means for assembling the heating coil assembly which simultaneously axially and radially positions and retains the elements thereof.

Another object of the present invention is to provide such a heating coil assembly which rapidly and
15 effectively elevates the temperature of a high volume of moving air yet provides sufficient insulation from surrounding components so as to minimize heat transfer thereto, thereby contributing to safer operation of the device containing the assembly.

The above objects are inventively achieved in a hot air gun having a housing consisting of two joined mirror-image halves, each of which has a plurality of brackets therein for supporting components such as a switch assembly, a circuit board, a motor with an impeller,
20 a motor mount, a shroud surrounding the impeller and a heater unit, within the housing. The motor, motor mount, shroud and heater unit are retained in the brackets so as to form a continuous assembly. The brackets for supporting this assembly are formed in spaced pairs, with adjacent flanges of the respective units being received between the brackets, and being retained therein when the two halves of the housing are joined and held
25 together by suitable fasteners.

In order to provide a tight press fit, the flange
30 may be made wave-like along a portion of the circumference to increase flange thickness to exert pressure between the brackets to maintain the adjacency of the flanges received between the brackets, as well a tightly

1 retaining the entire assembly so that no rattle or other
5 vibration-induced noise results during operation of the
air gun.

The brackets are arranged within the housing with
5 radial spaces therebetween so as to provide a plurality
of air inlet passages in cooperation with the interior
housing wall and the exterior walls of the various
components. The housing for the gun has a plurality of
10 air inlet openings at a rear thereof through which air
is drawn by the action of the motor-driven impeller, and
which is subsequently blown across a resistance coil of
the heater unit. Additionally, the gun has an annular
air inlet opening at a front portion thereof surrounding
15 the metal casing of the heater unit. Air is also drawn
through this opening and is thus preheated by the heat
dissipated through the metal casing and case halves.
This air is further drawn by the action of the impeller
through the passages formed by the support brackets in
20 the housing to a rear of the impeller, and the preheated
air is thus directed with the unheated inlet air over
the coil for primary heating thereof.

The hot air blower further includes an assembly
having an impeller with a plurality of curved blades
radially extending therefrom which is rotated by a motor
25 for moving air through a blower device. The impeller is
completely surrounded by an annular shroud having a
plurality of air passages therein, also extending radially
from a center of the shroud; the passages being curved
substantially the same as the impeller blades. The air
30 moved by the impeller blades must pass through the
passages before entering the remainder of the blower
device. The passages accept substantially only air which
is already moving in the direction defined by the curve
of the impeller blades, and the curve of the openings,
35 thereby generating a uniform, substantially smooth air
flow through the remainder of the blower device.

1 The hot air blower also has a heating coil assembly
having an annular mounting element, which may be comprised
of plastic, and two ceramic end faces with a ceramic
core about which a resistance heating element is spirally
5 wound and a ceramic sleeve disposed therebetween. Each
element has a polygonal (i.e., rotation preventing)
centrally disposed bore therein for receiving a heavy
gauge polygonal wire retainer therethrough. The retainer
is swaged at one end and is fitted with a press fit washer
10 at its opposite end for simultaneously axially and
radially positioning and retaining all of the elements,
and further facilitating ease of assembly of the elements.

15 Each of the end faces which are disposed adjacent
the insulating sleeve surrounding the heating element
have veins extending toward the interior of the sleeve
which are received in the sleeve so as to form in
combination a cylindrical insulating shield for the
heating element.

ON THE DRAWINGS

20 Figure 1 is a side elevational view of a hot air
gun constructed in accordance with the principles of the
present invention.

Figure 2 is a front elevational view of the hot
air gun shown in Figure 1.

25 Figure 3 is a side elevational view, partly in
section, of the hot air gun shown in Figure 1 with
one-half of the housing removed exposing the interior
components.

Figure 4 is a sectional view of the hot air gun
30 shown in Figure 3 taken along line IV-IV.

Figure 5 is a sectional view of the hot air gun
shown in Figure 3 taken along line V-V.

35 Figure 6 is a side elevational view of one-half
of the housing shown in Figure 3 with the interior
components removed therefrom.

1 Figure 7 is a sectional view of a portion of the housing shown in Figure 6 taken along line VII-VII.

Figure 8 is a sectional view of a portion of the housing shown in Figure 6 taken along line VIII-VIII.

5 Figure 9 is a sectional view of a portion of the housing shown in Figure 5 taken along line IX-IX.

Figure 10 is a sectional view of the portion of the housing shown in Figure 9 taken along line X-X.

10 Figure 11 is a sectional view of an impeller and shroud assembly constructed in accordance with the principles of the present invention.

Figure 12 is a sectional view taken along line II-II of Fig. 11.

15 Figure 13 is an end view of the motor mount employed in the assembly shown in Fig. 11.

Figure 14 is a circuit diagram for the heating coil in the assembly shown in the following figures.

20 Figure 15 is a sectional view of a heating coil assembly constructed in accordance with the principles of the present invention.

Figure 16 is an end view of the heating coil assembly shown in Figure 15.

Figure 17 is an exploded perspective view of the heating coil assembly shown in Figure 15.

25 A hand-held hot air gun constructed in accordance with the principles of the present invention is shown in exterior side and front elevational views in Figures 1 and 2. The gun 1 has a housing comprised of two housing shells 2 and 3. When joined, the shells 2 and 3 provide
30 a pistol grip 4, a guard 5 joined to the grip 4 by a connector 22, and a barrel portion 6. The shells 2 and 3 further form an air inlet baffle 7 having a plurality of rearward air inlets 38, described in greater detail below. The shells 2 and 3 are held together by a plurality of
35 fasteners 8, such as screws. The exterior of the barrel portion 6 may have indentations 9 and 10 for receiving manufacturer's labels, warnings, and the like. The shells 2 and 3 may consist, for example, of plastic.

1 The housing formed by the joined shells 2 and 3
contains a heater unit 11, having an exterior metal
casing 13, a portion of which projects from an opening 14
at the front of the gun 1. As shown in Figure 6, the
5 opening 14 is formed by a rim 14a of each of the shells
2 and 3. The front of the casing 13, as best seen in
Figure 2, has a guard to prevent most objects from coming
into contact with the heating coil disposed inside the
casing 13. The guard is in the form of a centrally
10 disposed hub 13a having a plurality of radially extending
struts 13b joining the hub 13a to the casing 13. A
plurality of radial apertures 13c are thus formed between
the struts 13b for permitting outward flow of heated air.

15 The gun 1 has an actuator 16 which is part of a
switch assembly 36 (shown in Figure 3) received in the
housing formed by the shells 2 and 3. The actuator 16
projects to the exterior of the gun 1 through an elongated
opening 4a formed by the shells 2 and 3, and is slideable
therein to turn the motor operating the gun 1 on and off,
20 and to operate the motor at different speeds and the heater
at lower wattage and temperature ranges. A heavy duty
electrical cord 15 is received within the housing formed
by the shells 2 and 3 for supplying power to the gun 1.

As best seen in Figure 8, the two shells 2 and
25 3 are joined by a tongue-and-groove arrangement. A tongue
18 is carried at the perimeter of the shell 3 and a
complementary shaped groove 19 is carried along the
corresponding perimeter of the shell 2. When the tongue
18 is received in the groove 19, an interior seam 17 and
30 an exterior recess 17a are formed. The recess 17a
facilitates prying apart of the shells 2 and 3 if nec-
essary, after removal of the fasteners 8 and approves
appearance.

As shown in Figure 3, the gun 1 contains a
35 number of internally disposed components which are mounted
in the shells 2 and 3. It will be understood that the shells

1 2 and 3 are essentially mirror images, and therefor in
Figure 3 components are only shown received in the shell
3, and in Figure 6 only the details of the shell 3 are
shown. The main components received and retained in the
5 shells 2 and 3 are the aforementioned switch assembly 36,
a circuit board 51, a motor 69 having an impeller 40,
a motor mount 42, a shroud 41 surrounding the impeller 40,
and the aforementioned heater unit 11. Further details
10 of the cooperation among and mounting of these components
are described below. The switch assembly 36 is received
in spaced brackets 24a and 24b (shown in Figure 6) in
the housing shell 3. The switch assembly 36 is connected
via leads 37 in a standard manner to the exterior power
cord 15. The exterior power cord 15 terminates in a
15 flanged collar 35 which is received in an annular retainer
33 formed in the shell 3. The posts 34 may be provided
if the cord is to be equipped with a strain relief in
addition to a molded cord set relief.

The switch assembly 36 has further leads 37a
20 connected to the circuit board 51 in a standard manner.
The circuit board 51 includes rectifying components and
other circuitry necessary for operating the motor 69 and
providing two heat output settings, the details of which
are well known to those skilled in the art, and therefore
25 the specific wiring need not be described in greater
detail. The circuit board 51 is retained in spaced
brackets 50a and 50b formed in the shell 3.

The motor mount 42 has a plurality of radial fins
43 which in combination form an annular receptacle, as
30 best seen in Figure 4, for receiving the motor 69. The
motor 69 is held therein by suitable fasteners 64, such
as screws. As stated above, the motor 69 has a shaft 39
on which an impeller 40 having a plurality of radially
extending impeller vanes is mounted. The impeller 40
35 is rapidly rotated by the motor 69.

1 The impeller 40 is surrounded by a shroud 41
disposed adjacent to the motor mount 42. The shroud 41
collects and directs air moved by the impeller 40 and
communicates with the heater unit 11 for transporting the
5 air moved by the impeller 40 over a resistance heating
coil 44 in the heater unit 11. The heater unit 11 has
a plastic annular connector 52 which receives the shroud
41. The connector 52 is disposed adjacent a ceramic end
cap 46 having a plurality of radial vanes 48 extending
10 from a central hub 49 so as to provide a plurality of
radial apertures therebetween for permitting air flow
therethrough. The end cap 46 is adjacent a hollow
cylindrical ceramic sleeve 45 which is closed at its
opposite end by another identical end cap 46, also
15 having apertures therein for permitting air flow there-
through, so as to provide a ceramic shell for the
resistance heater coil 44. The coil 44 is helically
wound on a ceramic core disposed within the ceramic
shell. An insulating sleeve 12 is disposed between the
20 ceramic shell and the metal casing 13. As best seen in
Figure 5, the connector 52 has an interior rim 55 from
which a plurality of struts 56 radially inwardly project
and join a central hub 58. The hub 58 as well as the end
caps 46 and the ceramic core about which the coil 44 is
25 wound each have a central square bore therein for
receiving a square retainer 59 which fixes the relative
radial positions of those components. A plurality of
leads 60 for supplying current to the coil 44 are guided
by the connector 52 and are connected to the circuit
board 51 and power cord 15.

30 Each housing shell 2 and 3 has a plurality of
bracket pairs integrally formed in the interior thereof
for receiving and retaining the above-identified components.
Each shell has an upper forward bracket pair consisting
35 of brackets 25a and 25b forming a receptacle 25c there-
between. The bracket 25a has a substantially vertical
wall 25d and the bracket 25b has a corresponding sub-
stantially vertical wall 25e. When the halves 2 and 3

1 are joined, the vertical walls form an air passage 60 therebetween as shown in Figure 5.

Each housing shell 2 and 3 further has a forward central bracket pair consisting of brackets 26a and 26b forming a receptacle 26c therebetween. As also best seen in Figure 5, air passages 61a and 61b are formed between the upper forward bracket pair and the central forward bracket pair.

10 Each housing shell 2 and 3 further has a lower forward bracket pair consisting of brackets 27a and 27b, forming a receptacle 27c therebetween. The bracket 27a has a substantially vertical wall 27d and the bracket 27b has a substantially vertical wall 27e. As best seen in Figure 5, an air passage 63 is formed between these 15 vertical walls when the halves 2 and 3 are joined. Additional air passages 62a and 62b are formed between the central forward bracket pair and the lower forward bracket pair, the rear bracket pair 30a and 30b and 31a and 31b are similarly equipped at 66b and 65b.

20 Each housing shell 2 and 3 has an upper rear bracket pair 28a and 28b forming a receptacle 28c therebetween. The bracket 28a has a generally vertical wall 28d and the bracket 28b has a generally vertical wall 28e which, as best seen in Figure 4, form an air passage 67 25 when the halves 2 and 3 are joined.

Each housing shell 2 and 3 further has a central rear bracket pair consisting of brackets 30a and 30b forming a receptacle 30c therebetween. Additional air passages 66a and 66b, as best seen in Figure 4, are 30 formed between the upper rear bracket pair and the central rear bracket pair.

Each housing shell 2 and 3 also has a lower rear bracket pair consisting of brackets 31a and 31b forming a receptacle 31c therebetween. The bracket 31a has a 35 generally vertical wall 31d and the bracket 31b has a generally vertical wall 31e which, when the housing halves 2 and 3 are joined, form an air passage 68 therebetween, as best seen in Figure 4. Air passages 65a and 65b, as

1 best seen in Figure 4, are formed between the central rear
bracket pair and the lower rear bracket pair.

5 The housing shell 3 has a plurality of fastener-receiving bosses 23 for receiving the fasteners 8. The housing shell 2 has a plurality of apertures therein in registry with the bosses 23. Additionally, as shown in Figure 6, several of the brackets have supporting struts extending substantially perpendicularly therefrom for stiffening and strengthening the brackets. The struts
10 have not been numbered for purpose of clarity.

As shown in Figures 3 and 5, and in further detail in Figures 9 and 10, the connector 52 is forced into tight adjacent connection with the shroud 41 by a flange thickener 53 which extends around the periphery of the connector 52. The thickener 53, as shown in detail in Figure 9, is received, for example, between brackets 26a and 26b together with a hook 13e carried on a flange 13d of the metal casing 13 of the heater unit 11. The free end 13f of the hook 13e is slightly bent so as to facilitate insertion of the components between the brackets 26a and 26b by initially slightly spreading the brackets apart. This substantially eliminates vibration during operation, thereby contributing to longer component life and further contributing to quieter operation by minimizing vibration-induced noise and rattling. The mounting details shown in Figure 9 for the brackets 26a and 26b apply as well to all forward bracket pairs shown in Figure 6.

30 A peripheral rim 42a of the motor mount 42 and a peripheral rim of the shroud 41 is received between the three rearward pairs of brackets in the gun 1, as shown in Figures 3 and 4, and is thus tightly fixed, so as to provide a substantially sealed air communication passage therethrough.

35 As mentioned above, the rear baffle 7 of the gun 1 has a plurality of air inlet openings 38 therein. As shown in detail in Figure 7, the inlets 38 are formed by a plurality of stepped walls 21 which alternate with

1 curved walls 40, the inlets 38 being formed therebetween
above and below the curved walls 20.

Air flow within the gun 1 directed by a combination of the above identified air passages acting in cooperation with the components disposed in the interior of the gun 1 is indicated by the arrows shown in Figure 3. Air is drawn through the rear inlets 38 by the action of the impeller 40 through a radial opening 43a in the motor mount 42, passes over the vanes of the impeller 40, is collected by the shroud 51 and directed in a uniform stream over the heating coil 44, and exits the gun through the openings 48 in the end cap 46 and the openings 13c in the metal casing 13. Additionally, air is drawn inwardly through the opening 14 in the front of the gun 1 by the action of the impeller 40. This air passes between the exterior of the metal casing 13 of the heater unit 11 and the interior walls of the housing shells 2 and 3, and is thus preheated as it passes over the casing 13. After such preheating, the air is drawn through the passages 60, 61a, 61b, 62a, 62b and 63 shown in Figure 5. The air flows around the exterior of the shroud 41 and then through passages 67, 66a, 66b, 65a, 65b and 68 shown in Figure 4. The air is then drawn through the opening 43a and is mixed with the rear inlet air from the inlets 38 for primary heating by movement over the coil 44. Preheating of a portion of the ambient air not only raises the temperature of the output air without the expenditure of additional input power, thereby resulting in a higher output air temperature per energy unit input, but also reduces the temperature of the plastic housing shells 2 and 3 by drawing heat away therefrom with continuous air movement, resulting in improved operator comfort.

As described above, the entire unit is assembled using a small number of mechanical fasteners; the only mechanical fasteners required are the fasteners 64 for affixing the motor 69 to the motor mount 42, and the fasteners 8 used to hold the housing shells 2 and 3.

1 together. All other components are retained in the gun 1
by press fit.

5 The concept of reverse air flow from opening 14a both preheats a portion of the air and cools the housing around the heater unit 11. Testing has shown the reverse air flow to provide substantial improvement in performance material of operator protection and cooldown after use if the unit is supported tip up to provide natural convection flow through the unit from opening 38 through opening 14.

10 An impeller and shroud assembly for the blower device is generally referenced at 101 in Fig. 11. The assembly 101 has a shroud 41 which receives a motor mount 42 by press fit therein. The motor mount 42 has an indexing element in the form of a tab or projection 104 which is received in a complimentary recess 105 in the shroud 41. The shroud 41 tapers in the direction of air flow therethrough to an outlet port 106 which is received in a free end 107 of a channel in a connector 52 for transporting air from the assembly 101 to the remainder of the blower device.

15 20 An impeller 40 is disposed within the interior of the shroud 41. The impeller 40 as best seen in Fig. 12, has a plurality of curved radially extending blades 110 thereon, fanning outwardly from a central hub 112. Each blade 110 has an air moving surface 111 integrally formed thereon.

25 30 The shroud 41 has a plurality of internal lands 113 which are arranged so as to provide a plurality of spaced, radially extending curved apertures 114, as shown in Fig. 12. The curved apertures 114 assume a curve generally corresponding to the curve of the blades 110 of the impeller 40. As the impeller 40 is rotated, (described in greater detail below) the air moved by the impeller blades 110 will move along a path generally corresponding to the curve of the blades 110. The correspondingly shaped openings 35 114 thus admit air already moving in a direction corresponding to the shape of the opening, thus providing a substantially uniform flow of air through the outlet port 106.

1 The impeller 40 is rotated by a motor 69 having
a rotor 119 terminating in a shaft 39 received in the
hub 112 of the impeller 40. The motor 69 is received
in a recess 117 of the motor mount 42 formed by a
5 plurality of radial ribs or struts 43 so as to abut
against an annular ring 121 centrally disposed in the
motor mount 42. The ring 121 has a central opening 125
for receiving the rotor 119. The motor 69 is fixed in
place by suitable fastening means 64, such as machine
10 screws. The motor 69 has electrical leads 123. The
ribs 43 are each further strengthened by an enlarged
stiffener 124 and are connected to a peripheral ring 42a.
A solid web 115 spans the openings between each rib 43.
An annular air inlet 43a is formed between the webs 115
15 and the ring 121.

20 A heating coil assembly constructed in accordance
with the principles of the present invention is generally
referenced at 11 in Figure 15. The assembly 11 has an
annular support element 52, which may be comprised of
plastic, and a hollow cylindrical ceramic sleeve 203
closed at each end by respective ceramic end caps 204
and 205. Each end cap 204 and 205 has a central hub
49 (and 49a) from which a plurality of struts or vanes
radially extend so as to define a plurality of annularly
25 disposed openings or vents 206 in the end cap 204, and a
like plurality of openings or vents 208 in the end cap
205. The hubs 49 and 49a for each of the end caps 204
and 205, and the vanes radially extending therefrom,
extend slightly into the interior of the ceramic sleeve
30 203 so as to form a shoulder in combination with the
outer rim of the caps 204 and 205 so as to provide a
ceramic insulating shell or housing in combination with
the sleeve 203. A ceramic core 210 is centrally disposed
within the interior of the housing formed by the sleeve
35 203 and the end caps 204 and 205. The core 210 has a
helical groove 211 formed thereon which receives a
helical spiral heating coil 212. The heating coil 212
is of the type well known to those skilled in the art
and may consist, for example, of heavy gauge resistance

1 wire. The flights of the coil 212 may be further
separated and insulated by small projections 213 on the
core 210.

As shown in the circuit diagram in Figure 14,
5 the coil 212 has a center tap 218 and two end terminals
215 and 239. The center tap 218 is guided within a
radial slot 235 in the core 210 to the end of the core
210, at which point the wire 218 enters an aperture
10 207 in the end cap 204 and is connected to an exterior
wire 217 by a connector 219. One end terminal 215 of
the coil 212 is received and retained between two spaced
posts 242 formed on the core 210 and is conducted through
one of the apertures 206 in the end cap 204, wherein it
is connected to another exterior wire 214 by another
15 connector 216. The other end terminal 239 of the coil
212 extends through an axial channel 236 within the core
210, the channel 236 terminating in a radial slot 237
adjacent the end cap 205. The wire 239 is conducted
through the channel 236 and the slot 237 for connection
20 to the coil 212. The opposite end of the terminal 239
is conducted through another opening 241 in the end cap
204 wherein it is connected to another exterior wire
220 by means of another connector 238.

The annular support element 52 has a plurality of
25 exterior vanes 52a radially disposed around the periphery
thereof for positioning and retaining the support element
52, and the remainder of the assembly connected thereto,
in the housing of the blower device in which the heating
coil assembly 11 is to be employed. The annular support
30 element 52 further has a centrally disposed boss 225
from which a plurality of ribs or struts 221 radially
extend toward the outer rim thereof. The outer rim has
a passage 223 for permitting the exterior wires 214, 217
and 220 to exit for connection to a power source.

1 A cylindrical spacer 224, which may also be
comprised of ceramic material, extends centrally through
the annular support element 52 between the boss 225 and
the end cap 204. The entire assembly is held together,
5 and the relative positions of the elements fixed, by a
retainer 230 in the form of heavy gauge square wire.
The retainer 231 is swaged at one end 232 thereof.
Each element of the assembly 11 has a centrally disposed
square bore for receiving the retainer 231. The end cap
10 205 has a centrally disposed square bore 230, the core
210 has a centrally disposed square bore 229, the end
cap 204 has a centrally disposed square bore 228 and the
boss 225 of the annular support element 52 has a centrally
disposed square bore 226. The spacer 224 has a centrally
15 disposed bore 227, which may be square or circular, since
it is not absolutely necessary to radially restrain the
spacer 224. A washer 233 is disposed between the swaged
end 232 of the retainer 231 and the end cap 205. The
opposite free end of the retainer 231 extends slightly
20 beyond the boss 225 and has a press fit retaining washer
234, such as a Tinnerman nut, forced thereon. The washer
234 has a correspondingly shaped opening 240 therein and
is slightly bowed such that once in place the edges of
the opening 240 provides sufficient friction against the
25 retainer 231 so as to hold all of the elements together.
The elements are thus easily longitudinally fixed in
relative position, and the square cross section of the
retainer 231 received in the respective square bores
simultaneously radially fixes the relative positions of
30 the elements. It will be understood that although the
retainer 231 is shown as having a square cross section,
any polygonal cross section which prevents radial
rotation can be employed, such as a hex, triangle,
D-shape, or the like, the bores of the respective compon-
35 ents through which the retainer 231 extends being corres-
pondingly shaped.

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1 The entire assembly 11 can thus be easily assembled without the necessity of time-consuming adjustment of the various elements. The coil 212 can be wound on the core 210 and the leads extending therefrom easily inserted
5 appropriately through the end cap 204, after which all elements can be placed in succession on the retainer 231 as shown in the exploded view of Figure 17. The entire assembly can then be appropriately inserted within the blower device in which it is to be used.

10

1 CLAIMS:

We claim as our invention:

1. A hand-held hot air gun comprising:
a housing having a front opening; a heating
element in said housing; blower means in said housing
for directing air through said heating element; and air
passage means communicating with said front opening and
with said blower means for drawing fresh air into said
housing through said front opening over said heating
element for pre-heating said fresh air before being
blown through said heating element and out of said front
opening.
2. A hot air gun as claimed in claim 1 wherein
said heating element projects out of and beyond said
front opening.
3. A hot air gun as claimed in claim 1 wherein
said heating element has an external heat conducting
shell.
4. A hot air gun as claimed in claim 3 wherein
said external heat conducting shell has a radially
extending heat conducting flange disposed in said air
passages.
5. A hot air gun as claimed in claim 3 wherein
said exterior heat conducting shell is a metal tube.
6. A hot air gun as claimed in claim 5 wherein
said metal tube projects out of and beyond said front
opening.
7. A hand-held hot air gun as claimed in claim
1 wherein said blower means comprises:
a motor, a shroud, an impeller, and a motor mount
in said housing connected to said shroud for centrally
mounting said motor and said impeller with respect to
said shroud, said motor mount being solely supported
and retained by said brackets; and said plurality of
brackets additionally being a sole supporting and
retaining means for said motor, said shroud, and said
heating element in said housing.

1 8. A hand-held hot air gun as claimed in claim
7 wherein said plurality of brackets include a plurality of
rear brackets supporting and retaining said motor mount.

5 9. A hand-held hot air gun as claimed in claim
1 wherein said housing has a plurality of air inlets dis-
posed at a rear thereof, and at least one air inlet disposed
at a front thereof.

10 10. A hand-held hot air gun as claimed in claim
0 wherein said air inlet disposed at a front of said housing
is an annular inlet defined by a circular opening in a front
of said housing and said exterior surface of said heating
element.

15 11. A hand-held hot air gun as claimed in claim
1 wherein said plurality of brackets include a plurality of
front brackets supporting and retaining said heating element.

20 12. A hand-held hot air gun as claimed in claim
1 further comprising a motor mount in said housing for said
motor, and wherein said plurality of brackets consist of a
plurality of front brackets supporting and retaining said
heating element and a plurality of rear brackets supporting
and retaining said motor mount, and wherein said shroud is
press fit between said motor mount and said heating element
in sealed relation therewith.

25 13. A hand-held hot air gun as claimed in claim
1 wherein said plurality of brackets consists of a plurality
of bracket pairs, each bracket pair defining a receptacle
therebetween.

30 14. A hand-held hot air gun as claimed in claim
1 wherein said plurality of brackets symmetrically comprises
on each interior side of said housing:

35 a pair of spaced upper forward brackets; a pair
of spaced central forward brackets; a pair of spaced lower
forward brackets, said pair of central forward brackets
being spaced from said pairs of upper and lower forward
brackets so as to define air passages therebetween;

1 a pair of spaced upper rear brackets; a pair of spaced central rear brackets; a pair of spaced lower rear brackets, said pair of central rear brackets being spaced from said upper and lower pairs of rear brackets for defining air passages therebetween; said upper and lower forward pairs of brackets in one of said sides defining upper and lower air passages in cooperation with corresponding upper and lower forward pairs of brackets spaced therefrom in the other of said sides;

5 and said upper and lower rear pairs of brackets in one of said sides defining further upper and lower air passages in cooperation with corresponding upper and lower rear pairs of brackets spaced therefrom in said other of said sides.

10 15. A hand-held hot air gun as claimed in claim 1 wherein said heating element has a flange, and further comprising a sinusoidal spring substantially in registry with said flange and received in at least one of said brackets in said plurality of brackets with said flange for rigidly retaining said heating element and said shroud and said motor mount connected thereto within said housing.

15 20 25 30 35 16. A hand-held hot air gun as claimed in claim 1 wherein said blower means comprises:

a motor; an impeller connected to and rotated by said motor, said impeller having a plurality of radially extending curved vanes each having a curved air moving surface; and a shroud surrounding said impeller having an air outlet communicating with a remainder of said hot air gun downstream of said shroud, said shroud having a plurality of radially disposed curved apertures therein communicating with said air outlet and receiving air moved by said impeller, said apertures being curved substantially the same as said curved veins for providing a uniform, low-turbulent air flow to said remainder of said blower device.

1 17. A hand-held hot air gun as claimed in
claim 16 wherein said impeller further comprises a
centrally disposed hub from which said curved vanes
radially extend.

5 18. A hand-held hot air gun as claimed in
claim 16 wherein said motor has a drive shaft, and
wherein said drive shaft is centrally received in said
hub of said impeller.

10 19. A hand-held hot air gun as claimed in
claim 16 further comprising:

 a motor mount connected to said shroud and
having a centrally disposed means for receiving and
retaining said motor for centering said impeller within
said shroud.

15 20. A hand-held hot air gun as claimed in
claim 19 wherein said motor mount includes an exterior
rim connected to said shroud, a plurality of radial
struts extending from said rim and terminating in an
interior of said motor mount defining a circular
20 receptacle for said motor, and a plurality of solid
webs disposed between said struts.

25 21. A hand-held hot air gun as claimed in
claim 19 further comprising an indexing means carried on
said motor mount for radially positioning said motor
mount with respect to said shroud.

 22. A hand-held hot air gun as claimed in
claim 21 wherein said shroud has a radial recess therein,
and wherein said indexing means is a radial tab carried
on said motor mount and received in said recess.

30 23. A hand-held hot air gun as claimed in
claim 1 wherein said heating element comprises:

 a continuous ceramic core; a heating coil
helically wound on said core and having a plurality of
electrical leads; a continuous hollow ceramic sleeve
35 surrounding said core and coil; a pair of ceramic end
caps having a plurality of radial apertures therein
disposed at opposite ends of said core and coil forming
in combination with said sleeve a ceramic insulating

- 1 shell completely surrounding said core and coil, said leads extending through said apertures in one of said end caps; an annular support element disposed adjacent said one of said end caps and receiving said leads;
- 5 each of said core, said end caps and said annular support element having a centrally disposed polygonal bore therein; and a retainer having a cross section preventing rotation extending through said core, said end caps and said annular support element for
- 10 simultaneously axially and radially fixing and restraining said core, said end caps and said annular support element.

24. A hand-held hot air gun as claimed in claim 23 wherein each of said end caps comprises:

- 15 an outer rim; a centrally disposed hub through which said polygonal bore extends; and a plurality of radially extending vanes connecting said rim and said hub.

- 25 25. A hand-held hot air gun as claimed in claim 24 wherein said vanes and said hub have a larger axial dimension than said rim so as to extend into said hollow ceramic sleeve.

26. A hand-held hot air gun as claimed in claim 23 wherein said plurality of electrical leads is three, and wherein said ceramic core has a first radial slot therein for receiving a first of said leads, an axial channel extending along the entire length of said core for receiving a second of said leads, and a pair of spaced posts disposed on an exterior of said core for receiving a third of said leads.

1 27. A hand-held hot air gun as claimed in claim
26 wherein said ceramic core further includes a second
radially extending slot disposed at an opposite end of
said core from said first radially extending slot,
5 said channel for said second lead communicating with
said second radial slot for bringing said second lead
to said exterior of said core.

10 28. A hand-held hot air gun as claimed in
claim 23 wherein said annular support element has a
means for connecting said support element to said hot
air blower.

15 29. A hand-held hot air gun as claimed in
claim 23 wherein said annular support element comprises:
an exterior rim; a centrally disposed boss through
which said square bore extends; and a plurality of
radially extending struts connecting said rim and said
boss.

20 30. A hand-held hot air gun as claimed in
claim 29 further comprising a spacer disposed in said
annular support element between said boss and said one
of said end caps, said spacer having a centrally
disposed bore through which said retainer extends.

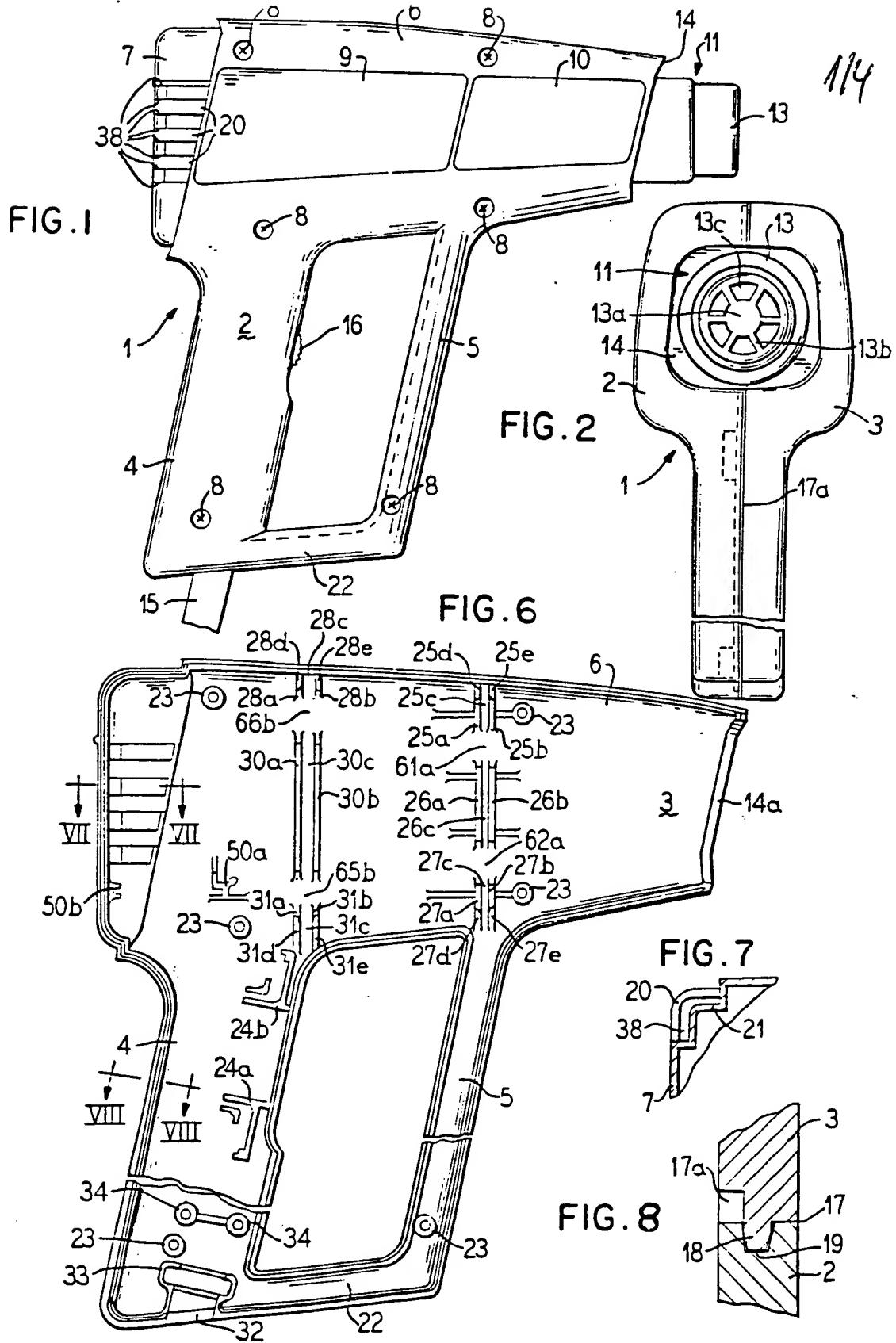
25 31. A hand-held hot air gun as claimed in
claim 30 wherein said spacer is comprised of ceramic
material.

30 32. A hand-held hot air gun as claimed in
claim 23 further comprising means disposed at opposite
ends of said retainer for restraining axial movement of
said retainer.

35 33. A hand-held hot air gun as claimed in
claim 32 wherein said means for restraining axial
movement of said retainer include a swaged end of said
retainer.

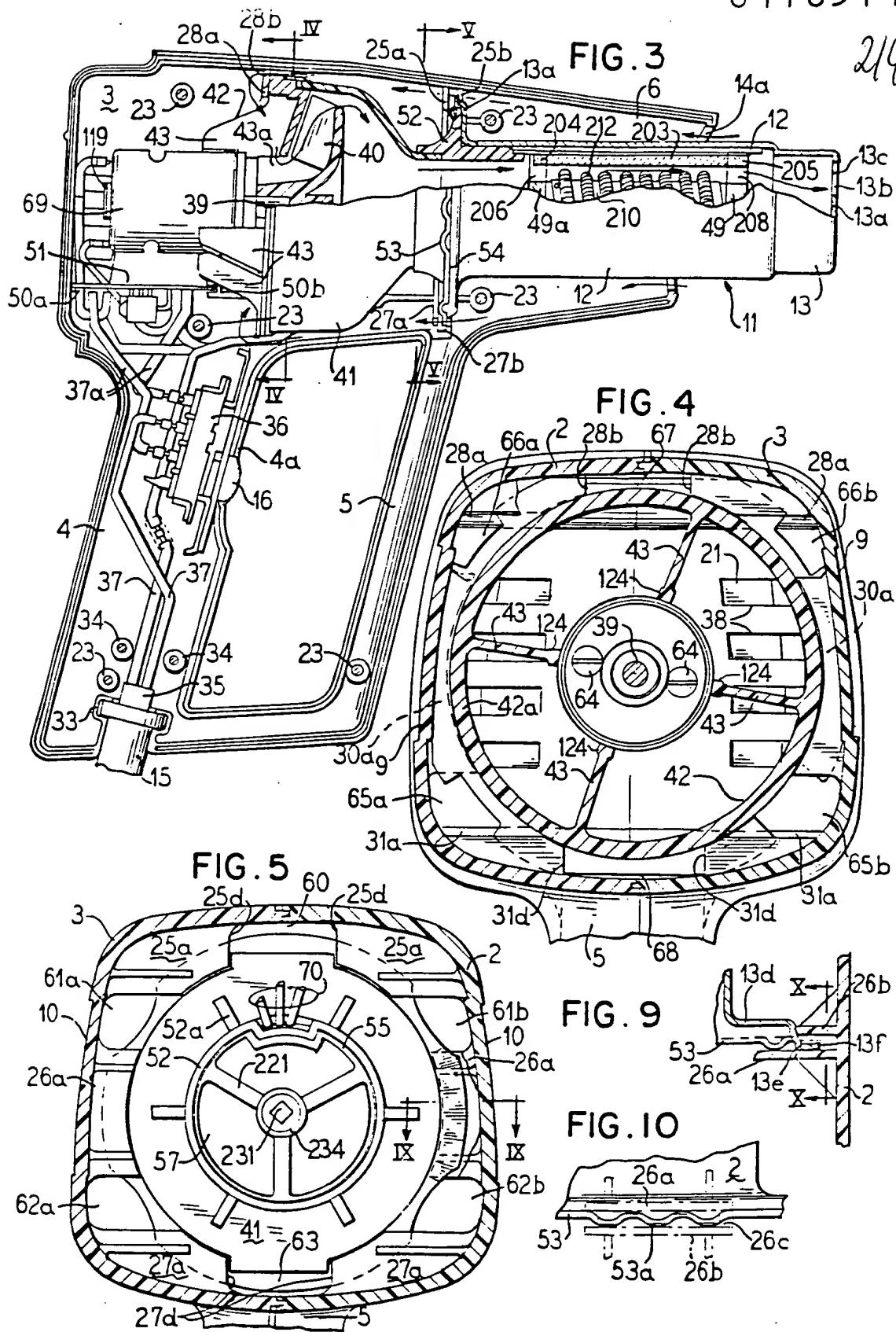
35 34. A hand-held hot air gun as claimed in
claim 32 wherein said means for restraining axial movement
of said retainer includes a press fit retaining washer
disposed at one end of said retainer adjacent said
annular support element.

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FIG. II

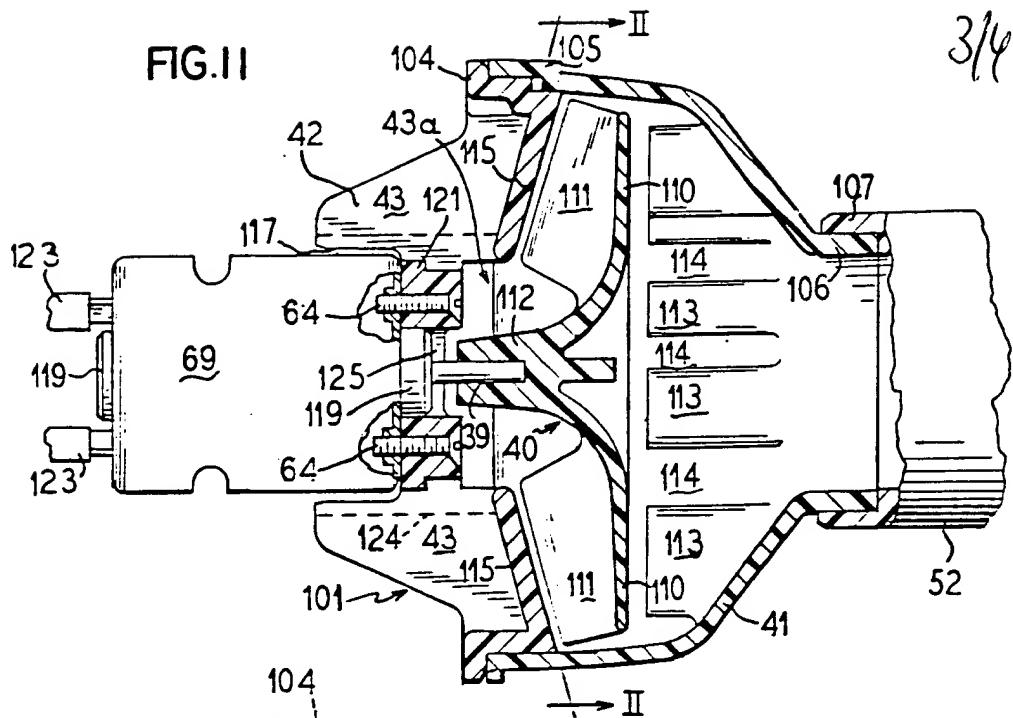


FIG13

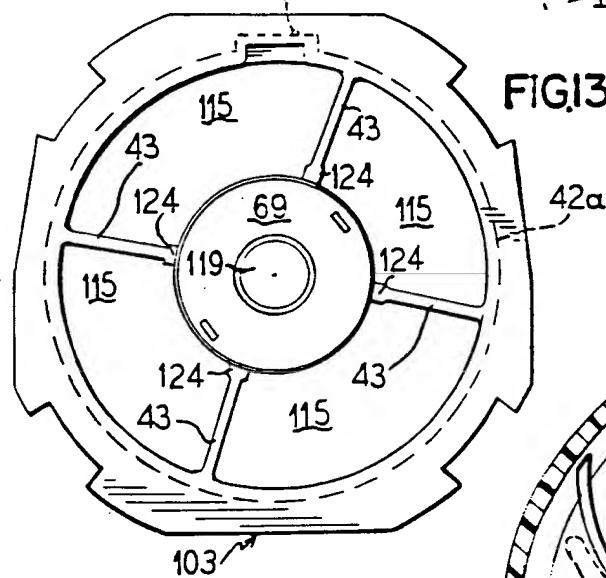
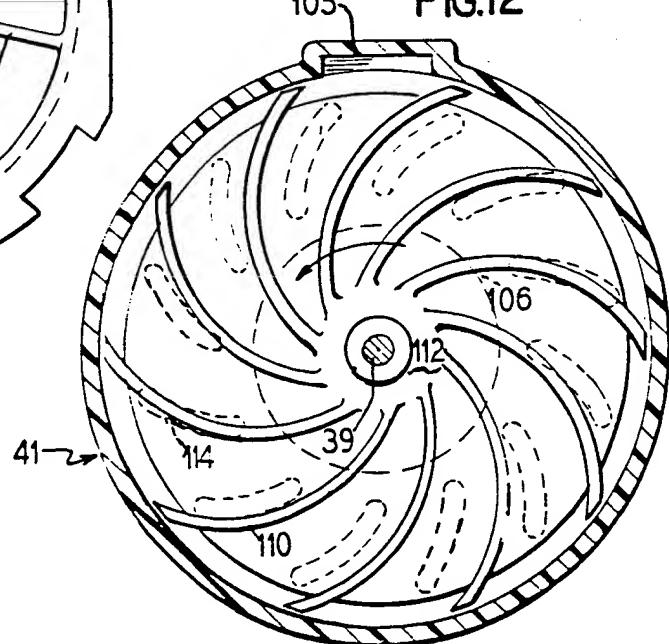


FIG.12



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